



Part of #14/B

# SEQUENCE LISTING

<110> Miller, Brian S.  
Shetty, Jayarama K.

<120> Modified Forms of Pullulanase

<130> GC396-2

<140> 09/262,126

<141> 1999-03-03

<160> 9 ✓

<170> FastSEQ for Windows Version 3.0

<210> 1

<211> 2794

<212> DNA

<213> Bacillus deramificans

<220>

<221> misc\_feature

<222> (1)...(2794)

<223> n = A, T, C, or G

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<211> 956

<212> PRT

<213> Bacillus deramificans

<220>

<221> VARIANT

<222> (1)...(956)

<223> Xaa = Any Amino Acid

<400> 2

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Thr	Thr	Thr	Ile	Ile	Val	His	Tyr	Phe	Cys	Pro	Ala	Gly	Asp	Tyr	Gln
		35					40					45			
Pro	Trp	Ser	Leu	Trp	Met	Trp	Pro	Lys	Asp	Gly	Gly	Gly	Ala	Glu	Tyr
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Asp	Phe	Asn	Gln	Pro	Ala	Asp	Ser	Phe	Gly	Ala	Val	Ala	Ser	Ala	Asp
65					70				75						80
Ile	Pro	Gly	Asn	Pro	Ser	Gln	Val	Gly	Ile	Ile	Val	Arg	Thr	Gln	Asp
			85					90						95	
Trp	Thr	Lys	Asp	Val	Ser	Ala	Asp	Arg	Tyr	Ile	Asp	Leu	Ser	Lys	Gly
		100						105				110			
Asn	Glu	Val	Trp	Leu	Val	Glu	Gly	Asn	Ser	Gln	Ile	Phe	Tyr	Asn	Glu
	115						120					125			
Lys	Asp	Ala	Glu	Asp	Ala	Ala	Lys	Pro	Ala	Val	Ser	Asn	Ala	Tyr	Leu
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Asp	Ala	Ser	Asn	Gln	Val	Leu	Val	Lys	Leu	Ser	Gln	Pro	Leu	Thr	Leu
145				150					155					160	
Gly	Glu	Gly	Xaa	Ser	Gly	Phe	Thr	Val	His	Asp	Asp	Thr	Ala	Asn	Lys
			165					170						175	
Asp	Ile	Pro	Val	Thr	Ser	Val	Lys	Asp	Ala	Ser	Leu	Gly	Gln	Asp	Val
	180						185					190			
Thr	Ala	Val	Leu	Ala	Gly	Thr	Phe	Gln	His	Ile	Phe	Gly	Gly	Ser	Asp
	195						200					205			
Trp	Ala	Pro	Asp	Asn	His	Ser	Thr	Leu	Leu	Lys	Lys	Val	Thr	Asn	Asn

210	215	220
Leu Tyr Gln Phe Ser Gly Asp Leu Pro Glu Gly Asn Tyr Gln Tyr Lys		
225	230	235
Val Ala Leu Asn Asp Ser Trp Asn Asn Ser Tyr Pro Ser Asp Asn Ile		
	245	250
Asn Leu Thr Val Pro Ala Gly Gly Ala His Val Thr Phe Ser Tyr Ile		
	260	265
Pro Ser Thr His Ala Val Tyr Asp Thr Ile Asn Asn Pro Asn Ala Asp		
	275	280
Leu Gln Val Glu Ser Gly Val Lys Thr Asp Leu Val Thr Val Thr Leu		
	290	295
Gly Glu Asp Pro Asp Val Ser His Thr Leu Ser Ile Gln Thr Asp Gly		
305	310	315
Tyr Gln Ala Lys Gln Val Ile Pro Arg Asn Val Leu Asn Ser Ser Gln		
	325	330
Tyr Tyr Tyr Ser Gly Asp Asp Leu Gly Asn Thr Tyr Thr Gln Lys Ala		
	340	345
Thr Thr Phe Lys Val Trp Ala Pro Thr Ser Thr Gln Val Asn Val Leu		
	355	360
Leu Tyr Asp Ser Ala Thr Gly Ser Val Thr Lys Ile Val Pro Met Thr		
	370	375
Ala Ser Gly His Gly Val Trp Glu Ala Thr Val Asn Gln Asn Leu Glu		
385	390	395
Asn Trp Tyr Tyr Met Tyr Glu Val Thr Gly Gln Gly Ser Thr Arg Thr		
	405	410
Ala Val Asp Pro Tyr Ala Thr Ala Ile Ala Pro Asn Gly Thr Arg Gly		
	420	425
Met Ile Val Asp Leu Ala Lys Thr Asp Pro Ala Gly Trp Asn Ser Asp		
	435	440
Lys His Ile Thr Pro Lys Asn Ile Glu Asp Glu Val Ile Tyr Glu Met		
	450	455
Asp Val Arg Asp Phe Ser Ile Asp Pro Asn Ser Gly Met Lys Asn Lys		
465	470	475
Gly Lys Tyr Leu Ala Leu Thr Glu Lys Gly Thr Lys Gly Pro Asp Asn		
	485	490
Val Lys Thr Gly Ile Asp Ser Leu Lys Gln Leu Gly Ile Thr His Val		
	500	505
Gln Leu Met Pro Val Phe Ala Ser Asn Ser Val Asp Glu Thr Asp Pro		
	515	520
Thr Gln Asp Asn Trp Gly Tyr Asp Pro Arg Asn Tyr Asp Val Pro Glu		
	530	535
Gly Gln Tyr Ala Thr Asn Ala Asn Gly Asn Ala Arg Ile Lys Glu Phe		
545	550	555
Lys Glu Met Val Leu Ser Leu His Arg Glu His Ile Gly Val Asn Met		
	565	570
Asp Val Val Tyr Asn His Thr Phe Ala Thr Gln Ile Ser Asp Phe Asp		
	580	585
Lys Ile Val Pro Glu Tyr Tyr Tyr Arg Thr Met Ile Gln Val Ile Ile		
	595	600
Pro Thr Asp Gln Val Leu Glu Met Lys Leu Xaa Ala Glu Arg Pro Met		
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Val Gln Lys Phe Ile Ile Asp Ser Leu Lys Tyr Trp Val Asn Glu Tyr		
625	630	635
His Ile Asp Gly Phe Arg Phe Asp Leu Met Ala Leu Leu Gly Lys Asp		
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Thr Met Ser Lys Ala Ala Ser Glu Leu His Ala Ile Asn Pro Gly Ile		
	660	665
		670

Ala	Leu	Tyr	Gly	Glu	Pro	Trp	Thr	Gly	Gly	Thr	Ser	Ala	Leu	Pro	Asp
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Asp	Gln	Leu	Leu	Thr	Lys	Gly	Ala	Gln	Lys	Gly	Met	Gly	Val	Ala	Val
	690					695					700				
Phe	Asn	Asp	Asn	Leu	Arg	Asn	Ala	Leu	Asp	Gly	Asn	Val	Phe	Asp	Ser
705					710					715					720
Ser	Ala	Gln	Gly	Phe	Ala	Thr	Gly	Ala	Thr	Gly	Leu	Thr	Asp	Ala	Ile
			725						730					735	
Lys	Asn	Gly	Val	Glu	Gly	Ser	Ile	Asn	Asp	Phe	Thr	Ser	Ser	Pro	Gly
		740						745					750		
Glu	Thr	Ile	Asn	Tyr	Val	Thr	Ser	His	Asp	Asn	Tyr	Thr	Leu	Trp	Asp
	755						760					765			
Lys	Ile	Ala	Leu	Ser	Asn	Pro	Asn	Asp	Ser	Glu	Ala	Asp	Arg	Ile	Lys
	770					775					780				
Met	Asp	Glu	Leu	Ala	Gln	Ala	Val	Val	Met	Thr	Ser	Gln	Gly	Val	Pro
785					790					795					800
Phe	Met	Gln	Gly	Gly	Glu	Glu	Met	Leu	Arg	Xaa	Lys	Gly	Gly	Asn	Asp
			805					810						815	
Asn	Ser	Tyr	Asn	Ala	Gly	Asp	Ala	Val	Asn	Glu	Phe	Asp	Trp	Ser	Arg
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Lys	Ala	Gln	Tyr	Pro	Asp	Val	Phe	Asn	Tyr	Tyr	Ser	Gly	Leu	Ile	His
	835						840					845			
Leu	Arg	Leu	Asp	His	Pro	Ala	Phe	Arg	Met	Thr	Thr	Ala	Asn	Glu	Ile
	850					855					860				
Asn	Ser	His	Leu	Gln	Phe	Leu	Asn	Ser	Pro	Glu	Asn	Thr	Val	Ala	Tyr
865				870						875					880
Glu	Leu	Thr	Asp	His	Val	Asn	Lys	Asp	Lys	Trp	Gly	Asn	Ile	Ile	Val
			885						890					895	
Val	Tyr	Asn	Pro	Asn	Lys	Thr	Val	Ala	Thr	Ile	Asn	Leu	Pro	Ser	Gly
		900						905					910		
Lys	Trp	Ala	Ile	Asn	Ala	Thr	Ser	Gly	Lys	Val	Gly	Glu	Ser	Thr	Leu
	915					920						925			
Gly	Gln	Ala	Glu	Gly	Ser	Val	Gln	Val	Pro	Gly	Ile	Ser	Met	Met	Ile
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Leu	His	Gln	Glu	Val	Ser	Pro	Asp	His	Gly	Lys	Lys				
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<210> 3  
 <211> 718  
 <212> PRT  
 <213> Bacillus subtilis

<400> 3

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Pro	Phe	Arg	Leu	Glu	Thr	Glu	Ile	Thr	Asp	Phe	Pro	Leu	Ala	Val	Arg
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Glu	Glu	Tyr	Ser	Leu	Glu	Ala	Lys	Tyr	Lys	Tyr	Val	Cys	Val	Ser	Asp
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His	Pro	Val	Thr	Phe	Gly	Lys	Ile	His	Cys	Val	Arg	Ala	Ser	Ser	Gly
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His	Lys	Thr	Asp	Leu	Gln	Ile	Gly	Ala	Val	Ile	Arg	Thr	Ala	Ala	Phe
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			100					105					110		

Asp	His	Thr	Val	Phe	Lys	Val	Trp	Ala	Pro	Ala	Ala	Thr	Ser	Ala	Ala		
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Val	Lys	Leu	Ser	His	Pro	Asn	Lys	Ser	Gly	Arg	Thr	Phe	Gln	Met	Thr		
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Arg	Leu	Glu	Lys	Gly	Val	Tyr	Ala	Val	Thr	Val	Thr	Gly	Asp	Leu	His		
		145			150					155					160		
Gly	Tyr	Glu	Tyr	Leu	Phe	Cys	Ile	Cys	Asn	Asn	Ser	Glu	Trp	Met	Glu		
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Thr	Val	Asp	Gln	Tyr	Ala	Lys	Ala	Val	Thr	Val	Asn	Gly	Glu	Lys	Gly		
			180					185					190				
Val	Val	Leu	Arg	Pro	Asp	Gln	Met	Lys	Trp	Thr	Ala	Pro	Leu	Lys	Pro		
		195					200					205					
Phe	Ser	His	Pro	Val	Asp	Ala	Val	Ile	Tyr	Glu	Thr	His	Leu	Arg	Asp		
		210				215					220						
Phe	Ser	Ile	His	Glu	Asn	Ser	Gly	Met	Ile	Asn	Lys	Gly	Lys	Tyr	Leu		
		225			230					235					240		
Ala	Leu	Thr	Glu	Thr	Asp	Thr	Gln	Thr	Ala	Asn	Gly	Ser	Ser	Ser	Gly		
			245						250					255			
Leu	Ala	Tyr	Val	Lys	Glu	Leu	Gly	Val	Thr	His	Val	Glu	Leu	Leu	Pro		
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			325					330						335			
Val	Phe	Asn	His	Val	Tyr	Lys	Arg	Glu	Asn	Ser	Pro	Phe	Glu	Lys	Thr		
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Val	Pro	Gly	Tyr	Phe	Phe	Arg	His	Asp	Glu	Cys	Gly	Met	Pro	Ser	Asn		
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Gly	Thr	Gly	Val	Gly	Asn	Asp	Ile	Ala	Ser	Glu	Arg	Arg	Met	Ala	Arg		
		370			375						380						
Lys	Phe	Ile	Ala	Asp	Cys	Val	Val	Tyr	Trp	Leu	Glu	Glu	Tyr	Asn	Val		
		385			390					395				400			
Asp	Gly	Phe	Arg	Phe	Asp	Leu	Leu	Gly	Ile	Leu	Asp	Ile	Asp	Thr	Val		
			405					410						415			
Leu	Tyr	Met	Lys	Glu	Lys	Ala	Thr	Lys	Ala	Lys	Pro	Gly	Ile	Leu	Leu		
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Ala	Ala	Leu	Ala	Asn	Ala	Pro	Arg	Met	Pro	Gly	Ile	Gly	Phe	Phe	Asn		
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Asp	Met	Phe	Arg	Asp	Ala	Val	Lys	Gly	Asn	Thr	Phe	His	Leu	Lys	Ala		
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Thr	Gly	Phe	Ala	Leu	Gly	Asn	Gly	Glu	Ser	Ala	Gln	Ala	Val	Met	His		
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Gly	Ile	Ala	Gly	Ser	Ser	Gly	Trp	Lys	Ala	Leu	Ala	Pro	Ile	Val	Pro		
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Glu	Pro	Ser	Gln	Ser	Ile	Asn	Tyr	Val	Glu	Ser	His	Asp	Asn	His	Thr		
		515				520						525					
Phe	Trp	Asp	Lys	Met	Ser	Phe	Ala	Leu	Pro	Gln	Glu	Asn	Asp	Ser	Arg		
		530				535					540						
Lys	Arg	Ser	Arg	Gln	Arg	Leu	Ala	Val	Ala	Ile	Ile	Leu	Leu	Ala	Gln		
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Gly	Val	Pro	Phe	Ile	His	Ser	Gly	Gln	Glu	Phe	Phe	Arg	Thr	Lys	Gln		

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			580						585				590				
Trp	Asp	Arg	Arg	Glu	Thr	Phe	Lys	Glu	Asp	Val	His	Tyr	Ile	Arg	Arg		
		595					600					605					
Leu	Ile	Ser	Leu	Arg	Lys	Ala	His	Pro	Ala	Phe	Arg	Leu	Arg	Ser	Ala		
	610					615					620						
Ala	Asp	Ile	Gln	Arg	His	Leu	Glu	Cys	Leu	Thr	Leu	Lys	Glu	His	Leu		
	625				630					635					640		
Ile	Ala	Tyr	Arg	Leu	Tyr	Asp	Leu	Asp	Glu	Val	Asp	Glu	Trp	Lys	Asp		
			645						650					655			
Ile	Ile	Val	Ile	His	His	Ala	Ser	Pro	Asp	Ser	Val	Glu	Trp	Arg	Leu		
			660					665					670				
Pro	Asn	Asp	Ile	Pro	Tyr	Arg	Leu	Leu	Cys	Asp	Pro	Ser	Gly	Phe	Gln		
		675					680					685					
Glu	Asp	Pro	Thr	Glu	Ile	Lys	Lys	Thr	Val	Ala	Val	Asn	Gly	Ile	Gly		
	690					695					700						
Thr	Val	Ile	Leu	Tyr	Leu	Ala	Ser	Asp	Leu	Lys	Ser	Phe	Ala				
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<210> 4  
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 <212> PRT  
 <213> Klebsiella pneumonia

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			20					25					30				
Pro	Asp	Thr	Pro	Asp	Asn	Gln	Asp	Val	Val	Val	Arg	Leu	Pro	Asp	Val		
			35				40					45					
Ala	Val	Pro	Gly	Glu	Ala	Val	Thr	Ala	Val	Glu	Asn	Gln	Ala	Val	Ile		
	50					55					60						
His	Leu	Val	Asp	Ile	Ala	Gly	Ile	Thr	Ser	Ser	Ser	Ala	Ala	Asp	Tyr		
	65				70					75				80			
Ser	Ser	Lys	Asn	Leu	Tyr	Leu	Trp	Asn	Asn	Glu	Thr	Cys	Asp	Ala	Leu		
			85					90					95				
Ser	Ala	Pro	Val	Ala	Asp	Trp	Asn	Asp	Val	Ser	Thr	Thr	Pro	Ser	Gly		
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Ser	Asp	Lys	Tyr	Gly	Pro	Tyr	Trp	Val	Ile	Pro	Leu	Asn	Lys	Glu	Ser		
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Gly	Cys	Ile	Asn	Val	Ile	Val	Arg	Asp	Gly	Thr	Asp	Lys	Leu	Ile	Asp		
	130					135					140						
Ser	Asp	Leu	Arg	Val	Ala	Phe	Gly	Asp	Phe	Thr	Asp	Arg	Thr	Val	Ser		
	145				150					155				160			
Val	Ile	Ala	Gly	Asn	Ser	Ala	Val	Tyr	Asp	Ser	Arg	Ala	Asp	Ala	Phe		
			165					170					175				
Arg	Ala	Ala	Phe	Gly	Val	Ala	Leu	Ala	Glu	Ala	His	Trp	Val	Asp	Lys		
			180					185					190				
Asn	Thr	Leu	Leu	Trp	Pro	Gly	Gly	Gln	Asp	Lys	Pro	Ile	Val	Arg	Leu		
		195				200						205					
Tyr	Tyr	Ser	His	Ser	Ser	Lys	Val	Ala	Ala	Asp	Gly	Glu	Gly	Lys	Phe		
	210					215					220						
Thr	Asp	Arg	Tyr	Leu	Lys	Leu	Thr	Pro	Thr	Thr	Val	Ser	Gln	Gln	Val		
	225				230					235					240		
Ser	Met	Arg	Phe	Pro	His	Leu	Ser	Ser	Tyr	Ala	Ala	Phe	Lys	Leu	Pro		



Leu	Asn	Pro	Asp	Ile	Tyr	Phe	Phe	Gly	Glu	Gly	Trp	Asp	Ser	Asn	Gln	705	710	715	720
Ser	Asp	Arg	Phe	Glu	Ile	Ala	Ser	Gln	Ile	Asn	Leu	Lys	Gly	Thr	Gly	725	730	735	735
Ile	Gly	Thr	Phe	Ser	Asp	Arg	Leu	Arg	Asp	Ser	Val	Arg	Gly	Gly	Gly	740	745	750	750
Pro	Phe	Asp	Ser	Gly	Asp	Ala	Leu	Arg	Gln	Asn	Gln	Gly	Ile	Gly	Ser	755	760	765	765
Gly	Ala	Gly	Val	Leu	Pro	Asn	Glu	Leu	Ala	Ser	Leu	Ser	Asp	Asp	Gln	770	775	780	780
Val	Arg	His	Leu	Ala	Asp	Leu	Thr	Arg	Leu	Gly	Met	Ala	Gly	Asn	Leu	785	790	795	800
Ala	Asp	Phe	Val	Met	Ile	Asp	Lys	Asp	Gly	Ala	Ala	Lys	Lys	Gly	Ser	805	810	815	815
Glu	Ile	Asp	Tyr	Asn	Gly	Ala	Pro	Gly	Gly	Tyr	Ala	Ala	Asp	Pro	Thr	820	825	830	830
Glu	Val	Val	Asn	Tyr	Val	Ser	Lys	His	Asp	Asn	Gln	Thr	Leu	Trp	Asp	835	840	845	845
Met	Ile	Ser	Tyr	Lys	Ala	Ser	Gln	Glu	Ala	Asp	Leu	Ala	Thr	Arg	Val	850	855	860	860
Arg	Met	Gln	Ala	Val	Ser	Leu	Ala	Thr	Val	Met	Leu	Gly	Gln	Gly	Ile	865	870	875	880
Ala	Phe	Asp	Gln	Gln	Gly	Ser	Glu	Leu	Leu	Arg	Ser	Lys	Ser	Phe	Thr	885	890	895	895
Arg	Asp	Ser	Tyr	Asp	Ser	Gly	Asp	Trp	Phe	Asn	Arg	Val	Asp	Tyr	Ser	900	905	910	910
Leu	Gln	Asp	Asn	Asn	Tyr	Asn	Val	Gly	Met	Pro	Arg	Ile	Ser	Asp	Asp	915	920	925	925
Gly	Ser	Asn	Tyr	Glu	Val	Ile	Thr	Arg	Val	Lys	Glu	Met	Val	Ala	Thr	930	935	940	940
Pro	Gly	Glu	Ala	Glu	Leu	Lys	Gln	Met	Thr	Ala	Phe	Tyr	Gln	Glu	Leu	945	950	955	960
Thr	Glu	Leu	Arg	Lys	Ser	Ser	Pro	Leu	Phe	Thr	Leu	Gly	Asp	Gly	Ser	965	970	975	975
Ala	Val	Met	Lys	Arg	Val	Asp	Phe	Arg	Asn	Thr	Gly	Ser	Asp	Gln	Gln	980	985	990	990
Ala	Gly	Leu	Val	Met	Thr	Val	Asp	Asp	Gly	Met	Lys	Ala	Gly	Ala		995	1000	1005	1005
Ser	Leu	Asp	Ser	Arg	Leu	Asp	Gly	Leu	Val	Val	Ala	Ile	Asn	Ala	Ala	1010	1015	1020	1020
Pro	Glu	Ser	Arg	Thr	Leu	Asn	Glu	Phe	Ala	Gly	Glu	Thr	Leu	Gln	Leu	1025	1030	1035	1040
Ser	Ala	Ile	Gln	Gln	Thr	Ala	Gly	Glu	Asn	Ser	Leu	Ala	Asn	Gly	Val	1045	1050	1055	1055
Gln	Ile	Ala	Ala	Asp	Gly	Thr	Val	Thr	Leu	Pro	Ala	Trp	Ser	Val	Ala	1060	1065	1070	1070
Val	Leu	Glu	Leu	Pro	Gln	Gly	Glu	Ala	Gln	Gly	Ala	Gly	Leu	Pro	Val	1075	1080	1085	1085
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